EVALUATION OF HYDRIDE COMPRESSOR ELEMENTS FOR THE PLANCK SORPTION CRYOCOOLER

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Hydrogen sorption cryocoolers are being developed for the European Space Agency Planck mission to provide nominal 20 K cooling to instruments for measuring the temperature anisotropy of the cosmic microwave background with extreme sensitivity and resolution. The behavior of the metal hydride sorbent beds used in the compressor dominates both the performance and reliability of these sorption cryocoolers. The compressor elements have been designed to minimize their input power requirements and to enhance durability during extended temperature cycling while in operation. The Lanthanum-Nickel-Tin alloy $LaNi_{4.78}Sn_{0.22}$ in the sorbent beds circulates and compresses the hydrogen refrigerant gas while the ZrNi alloy is used to provide variable pressure in the gas-gap heat switches for each compressor element. Characterization tests have been performed on the compressor elements built for an engineering breadboard (EBB) cooler to evaluate the behavior of both the sorbent bed and gas-gap switches under conditions simulating flight operation. These results provide a basis for predicting EBB cooler performance and are also compared to thermal model analyses to identify any design deficiencies prior to fabrication of the flight compressor elements. In addition, experiments were done on compressor elements that had been operated for several thousand cycles to assess degradation in the sorbent hydride and reduction in the effectiveness of the gas gap switches in reducing parasitic heat losses

Prefer Oral Presentation

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